Unraveling the Complex Site Mystery

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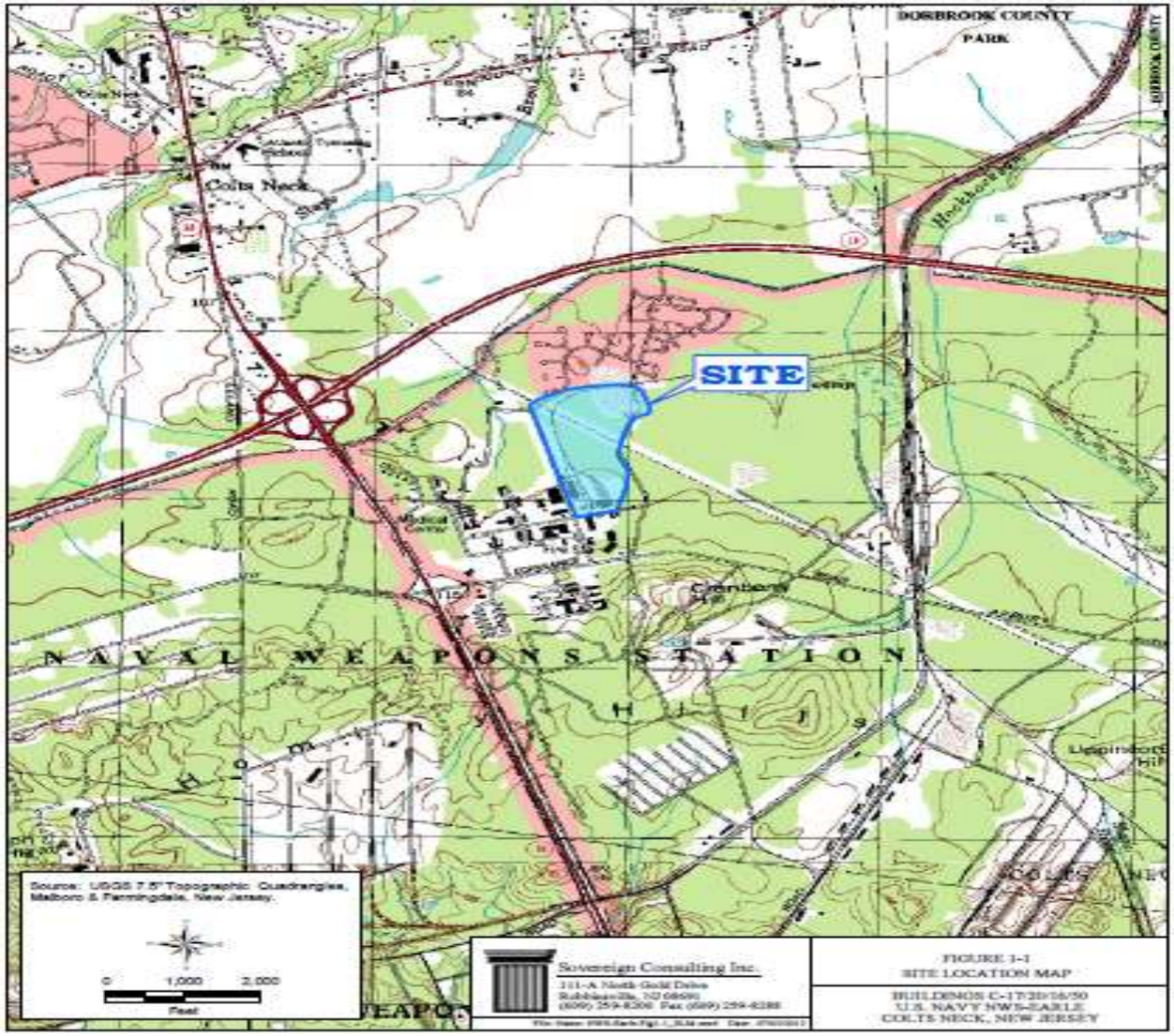
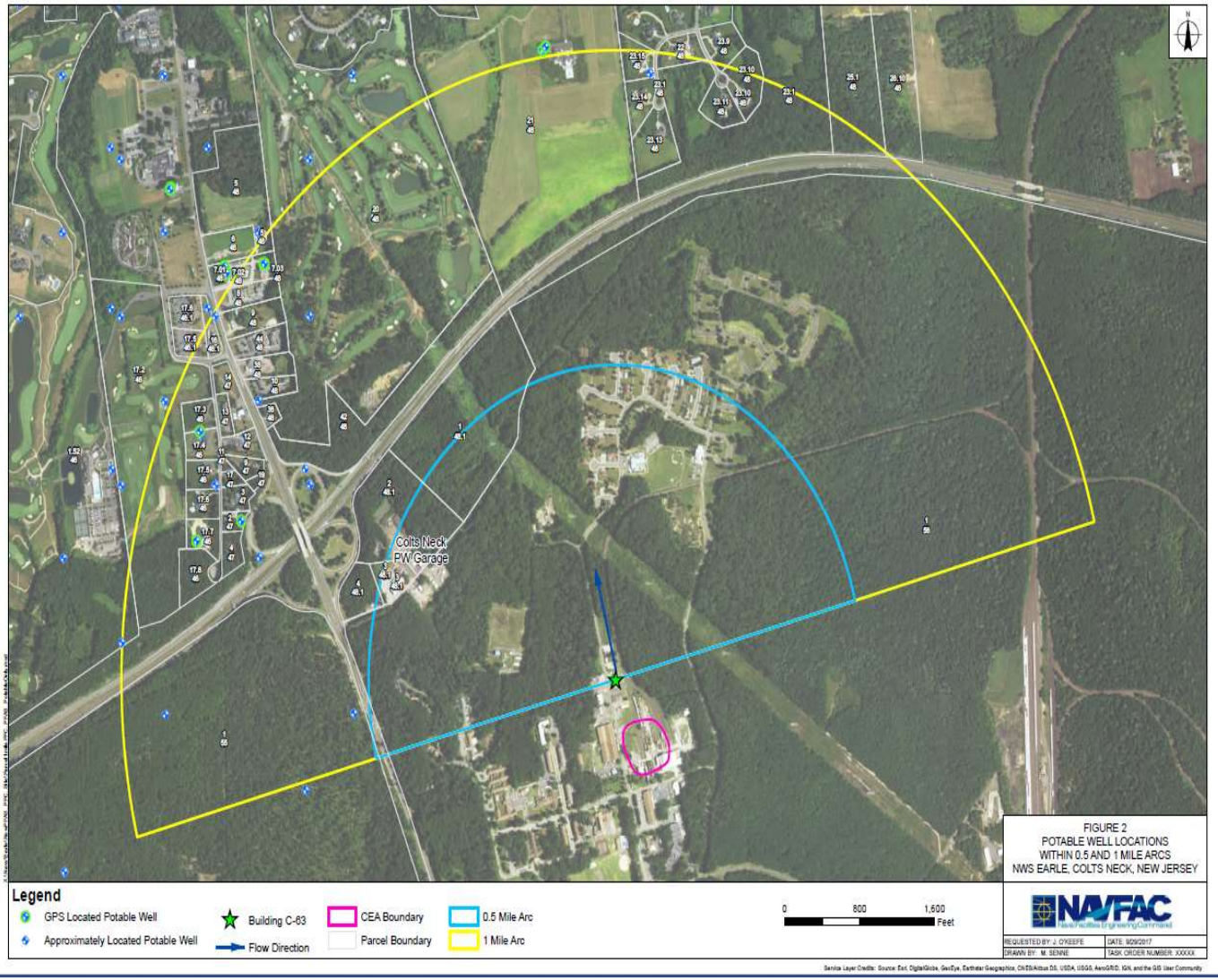
Fundamentals Matter

- Because of these sites are complex the path to restoration tends to be more iterative.
- Complex sites will require a more in depth analytical approach when investigating and developing the CSM.
- The refining of the CSM is critical as new data, technological considerations all impact the process.
- As a result of using this approach or adaptive site management the decision making will be easier, more productive, and less likely to make major errors.
- The remediation of a site is complex, however, if fundamentals of an investigations are not complete, or wrong then remediation can be costly.

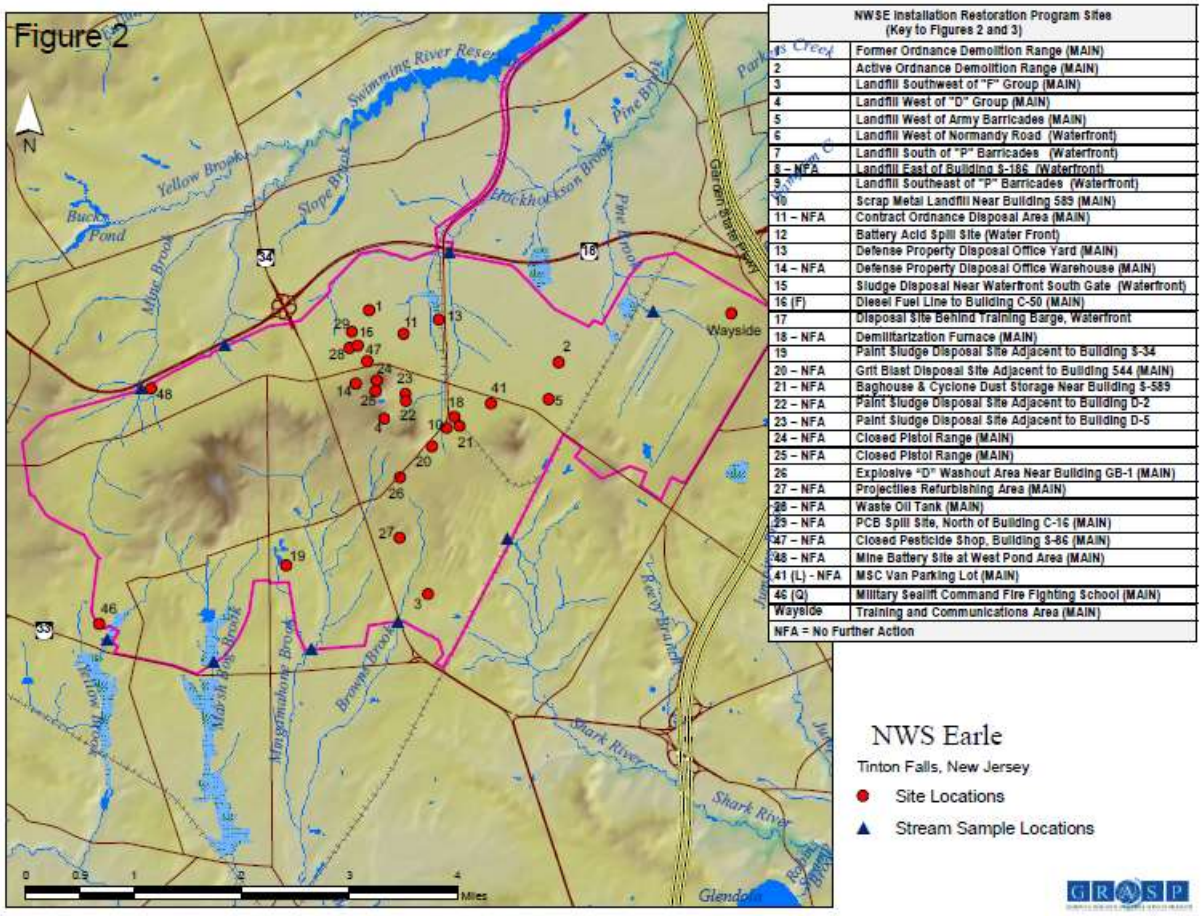
Site Location Map



Case Study Earle, NJ



Sites of Concern



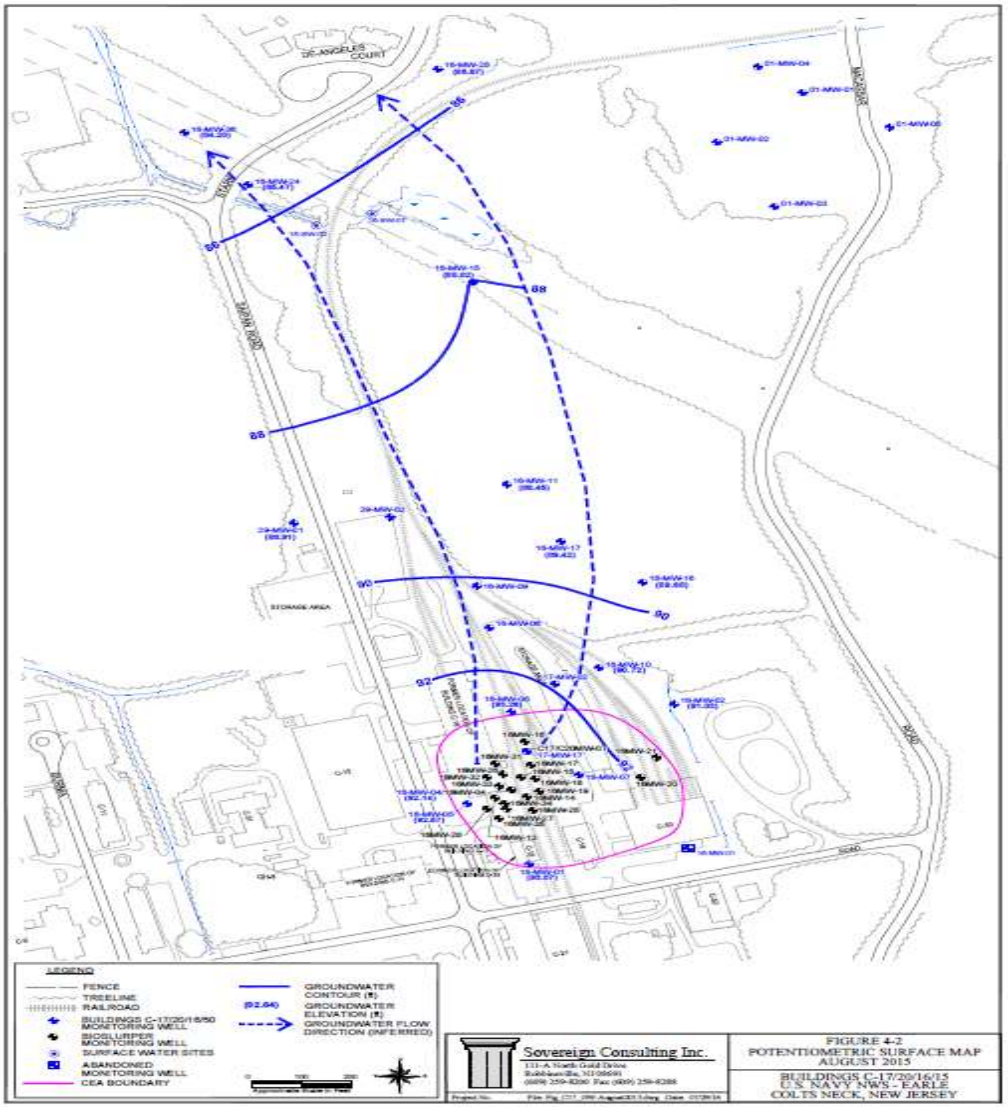
NWSE Installation Restoration Program Sites (Key to Figures 2 and 3)	
1	Former Ordnance Demolition Range (MAIN)
2	Active Ordnance Demolition Range (MAIN)
3	Landfill Southwest of "F" Group (MAIN)
4	Landfill West of "D" Group (MAIN)
5	Landfill West of Army Barricades (MAIN)
6	Landfill West of Normandy Road (Waterfront)
7	Landfill South of "P" Barricades (Waterfront)
8 – NFA	Landfill East of Building S-186 (Waterfront)
9	Landfill Southeast of "P" Barricades (Waterfront)
10	Scrap Metal Landfill Near Building 589 (MAIN)
11 – NFA	Contract Ordnance Disposal Area (MAIN)
12	Battery Acid Spill Site (Water Front)
13	Defense Property Disposal Office Yard (MAIN)
14 – NFA	Defense Property Disposal Office Warehouse (MAIN)
15	Sludge Disposal Near Waterfront South Gate (Waterfront)
16 (F)	Diesel Fuel Line to Building C-50 (MAIN)
17	Disposal Site Behind Training Barge, Waterfront
18 – NFA	Demilitarization Furnace (MAIN)
19	Paint Sludge Disposal Site Adjacent to Building S-34
20 – NFA	Grit Blast Disposal Site Adjacent to Building 544 (MAIN)
21 – NFA	Baghouse & Cyclone Dust Storage Near Building S-585
22 – NFA	Paint Sludge Disposal Site Adjacent to Building D-2
23 – NFA	Paint Sludge Disposal Site Adjacent to Building D-5
24 – NFA	Closed Pistol Range (MAIN)
25 – NFA	Closed Pistol Range (MAIN)
26	Explosive "D" Washout Area Near Building GB-1 (MAIN)
27 – NFA	Projectiles Refurbishing Area (MAIN)
28 – NFA	Waste Oil Tank (MAIN)
29 – NFA	PCB Spill Site, North of Building C-16 (MAIN)
47 – NFA	Closed Pesticide Shop, Building S-86 (MAIN)
48 – NFA	Mine Battery Site at West Pond Area (MAIN)
41 (L) - NFA	MSC Van Parking Lot (MAIN)
46 (Q)	Military Sealift Command Fire Fighting School (MAIN)
Wayside	Training and Communications Area (MAIN)
NFA = No Further Action	

Initial Site CSM

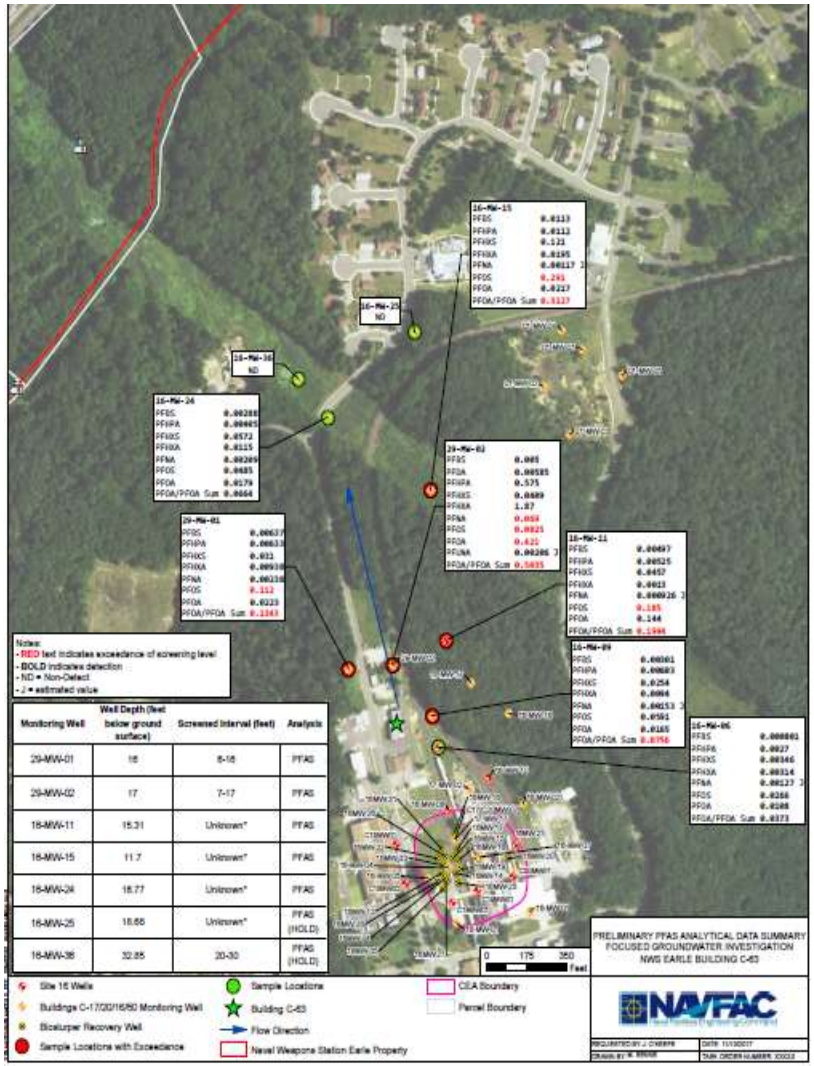
- The initial CSM was based on shallow groundwater data indicating flow to the northwest.
- Off site residential water supplies were thought to be at risk from potential contaminants.
- Very little was understood about the depth and construction of these residential water supply wells.
- In order to decide if the offsite water supplies were truly at risk, additional research was conducted consisting of records reviews and geological databases.

Potentiometric Map Shallow Aquifer

(Courtesy Sovereign)



PFAS DATA


PRELIMINARY PFAS ANALYTICAL DATA SUMMARY
FOCUSED GROUNDWATER INVESTIGATION
NWS EARLE BUILDING C-63
Site 16 Wells
Buildings C-17/20/16/80 Monitoring Well
Bioslurper Recovery Well
Sample Locations with Exceedance
Sample Locations
Building C-63
Flow Direction
Naval Weapons Station Earle Property
CEA Boundary
Parcel Boundary
Feet

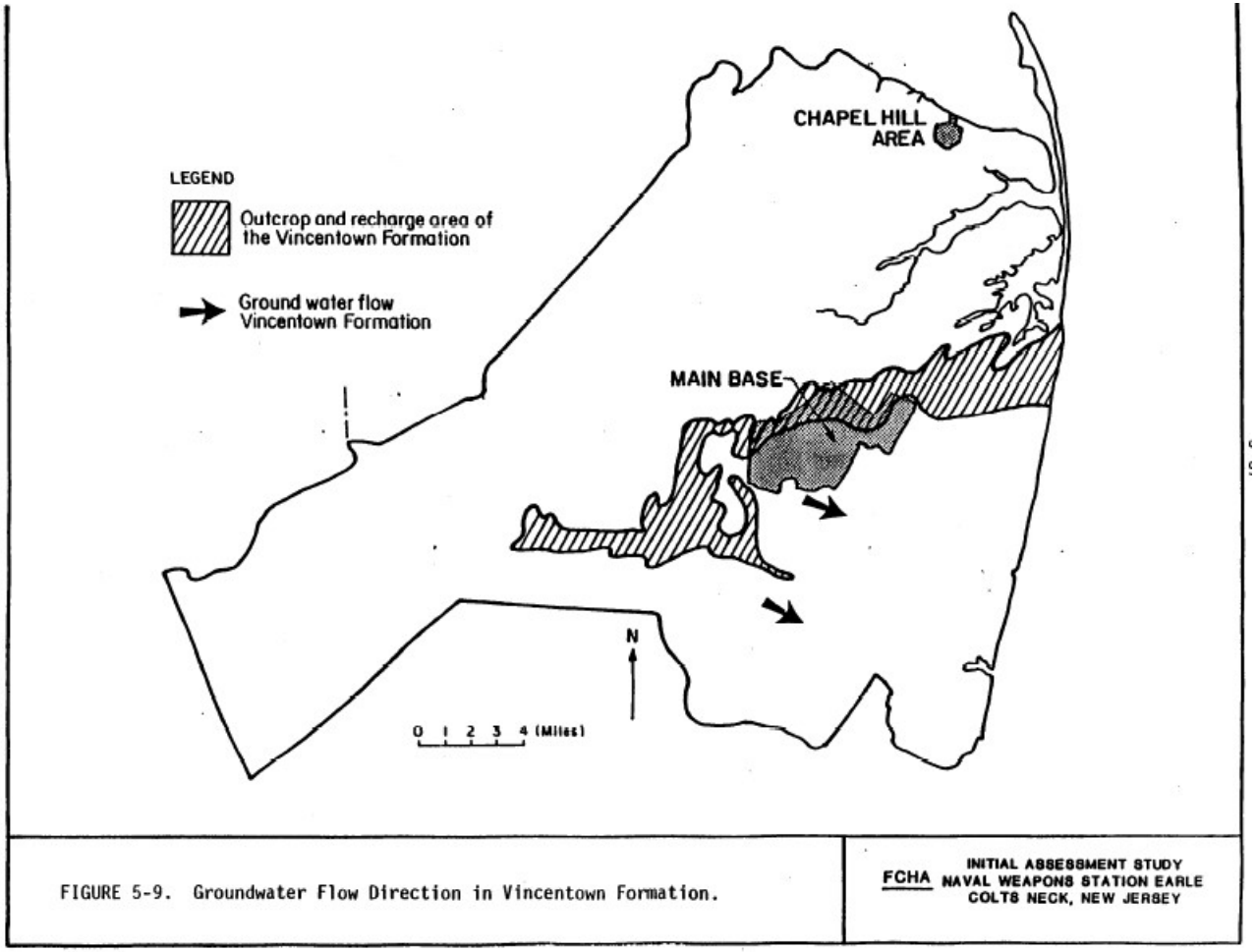
Off Site Well Log

Log of Well 1.5 Miles Northwest of NWS Earle-Main Base

Formation	Thickness (feet)	Depth (feet)
Cretaceous:		
Sand, brown, clayey, glauconitic	10	10
Sand, brown, clayey, indurated, glauconitic	15	25
Red Bank Sand:		
Sand, reddish-brown, fine to coarse	35	60
Sand, greenish-gray, fine to medium	65	125
Navesink Formation:		
Clay (?), gray, sandy, glauconitic, very fossiliferous	35	160
Clay, greenish-gray, very glauconitic	5	165
Wenonah Formation and Mount Laurel Sand:		
Sand, fine, micaceous, clayey	35	200
Sand, and clay, gray, fine	10	210
Sand, gray, fine, clayey micaceous and glauconitic	30	240
Wenonah (?) Formation:		
Clay, gray, contains thin laminae of fine sand	5	245
Clay, gray, sandy	15	260
Clay, gray, sandy, micaceous	20	280
Marshalltown Formation:		
Clay, gray, contains thin laminae of fine sand	20	300
Clay, sandy, contains shell fragments	10	310
Englishtown (?) Formation:		
Clay and sand. Sand is fine and micaceous	20	330
Englishtown Formation:		
Sand, gray, very fine to medium, slightly clayey	20	350
Englishtown (?) Formation:		
Clay, slightly sandy	50	400
Woodbury Clay:		
Clay, gray, micaceous, contains shell fragments	50	450
Clay, greenish-gray, micaceous	24	474
Merchantville Formation:		
Sand, gray, fine, contains pyrite and limonite	6	480
Clay, greenish-gray, sandy, micaceous, slightly fossiliferous	40	520
Clay, greenish-gray	30	550

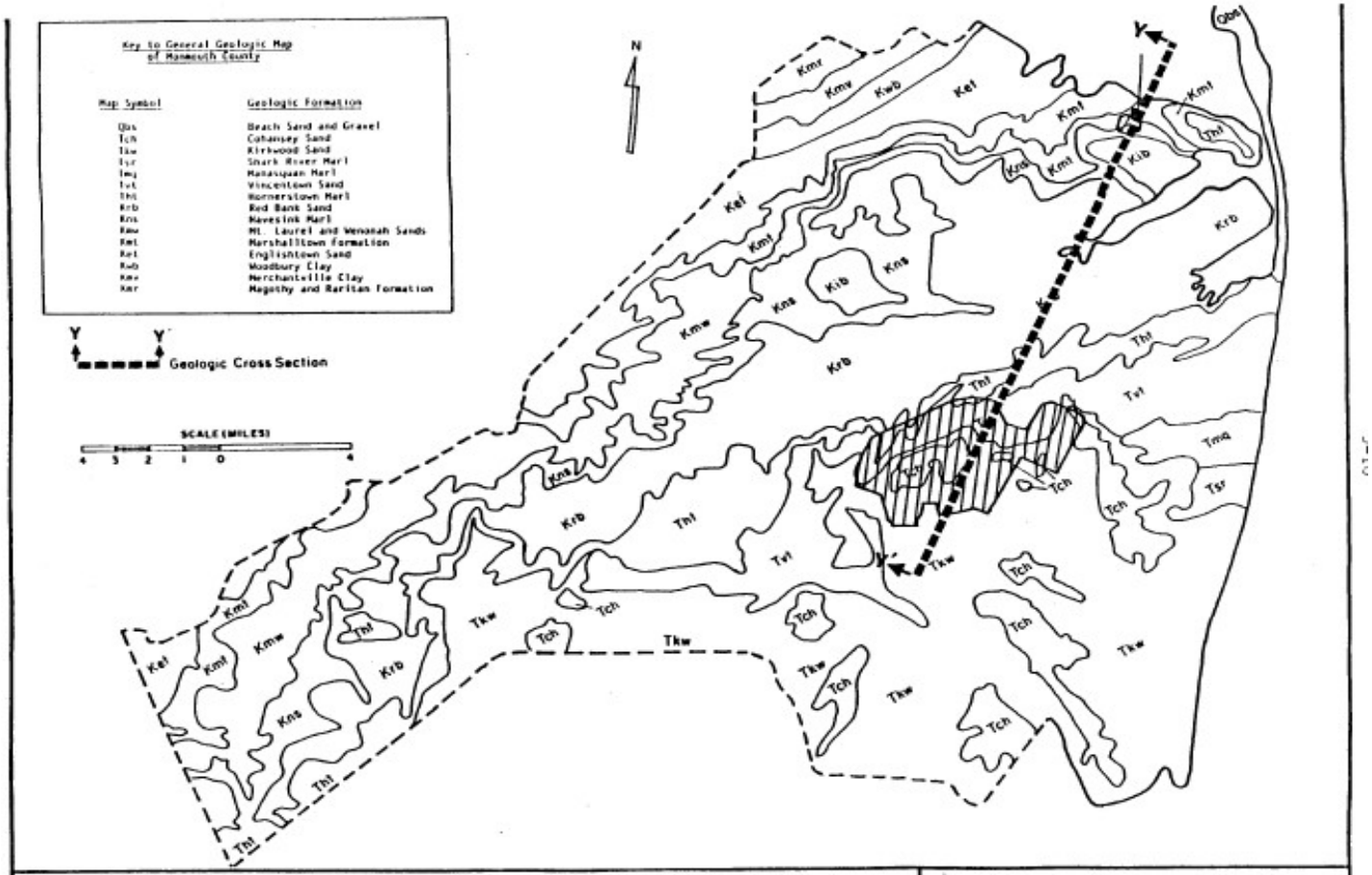
Groundwater Flow Vincentown Formation

(Courtesy Hart)



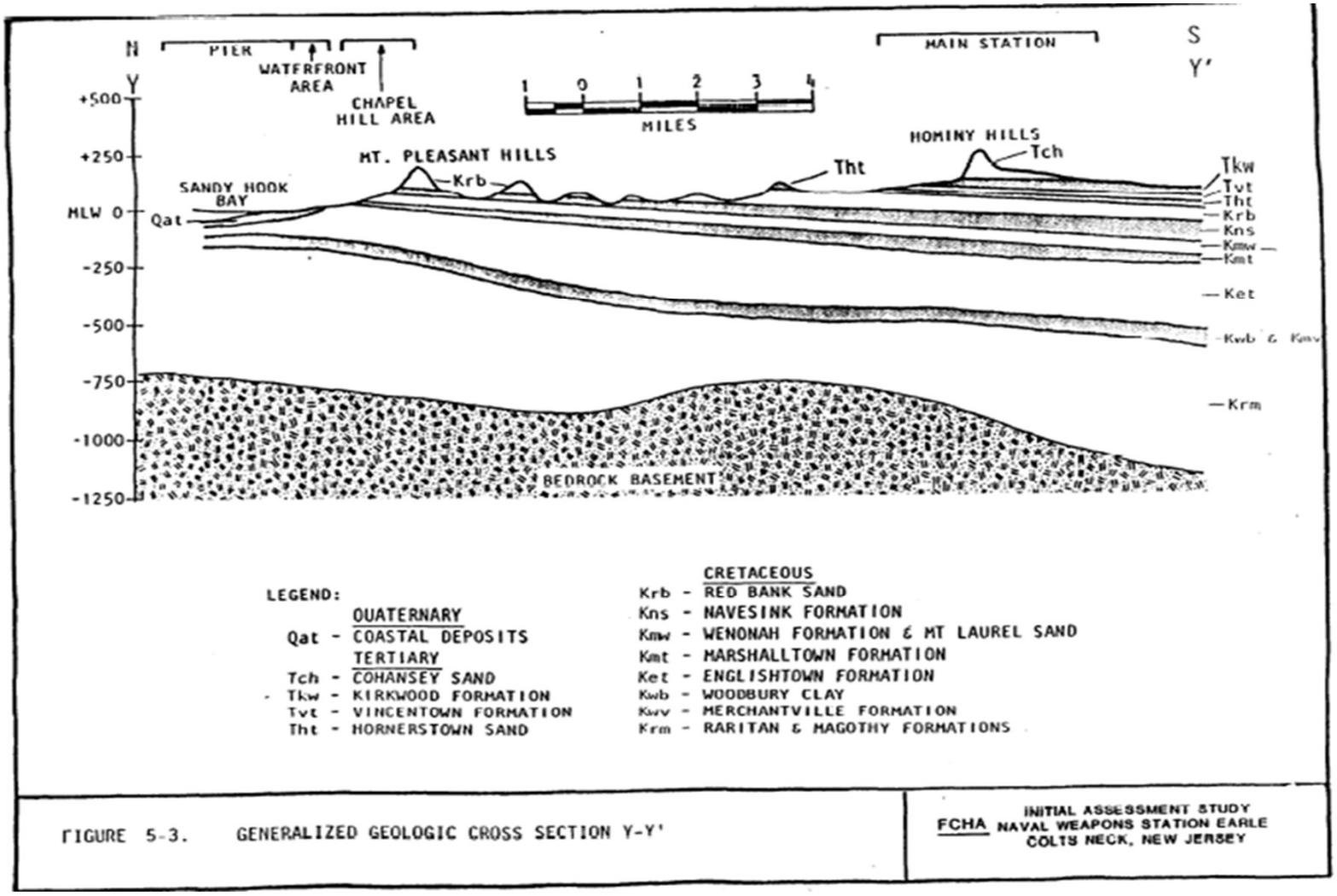
Geologic Cross Section

(Courtesy Hart)



Stratigraphic Cross Section

(Courtesy Hart)

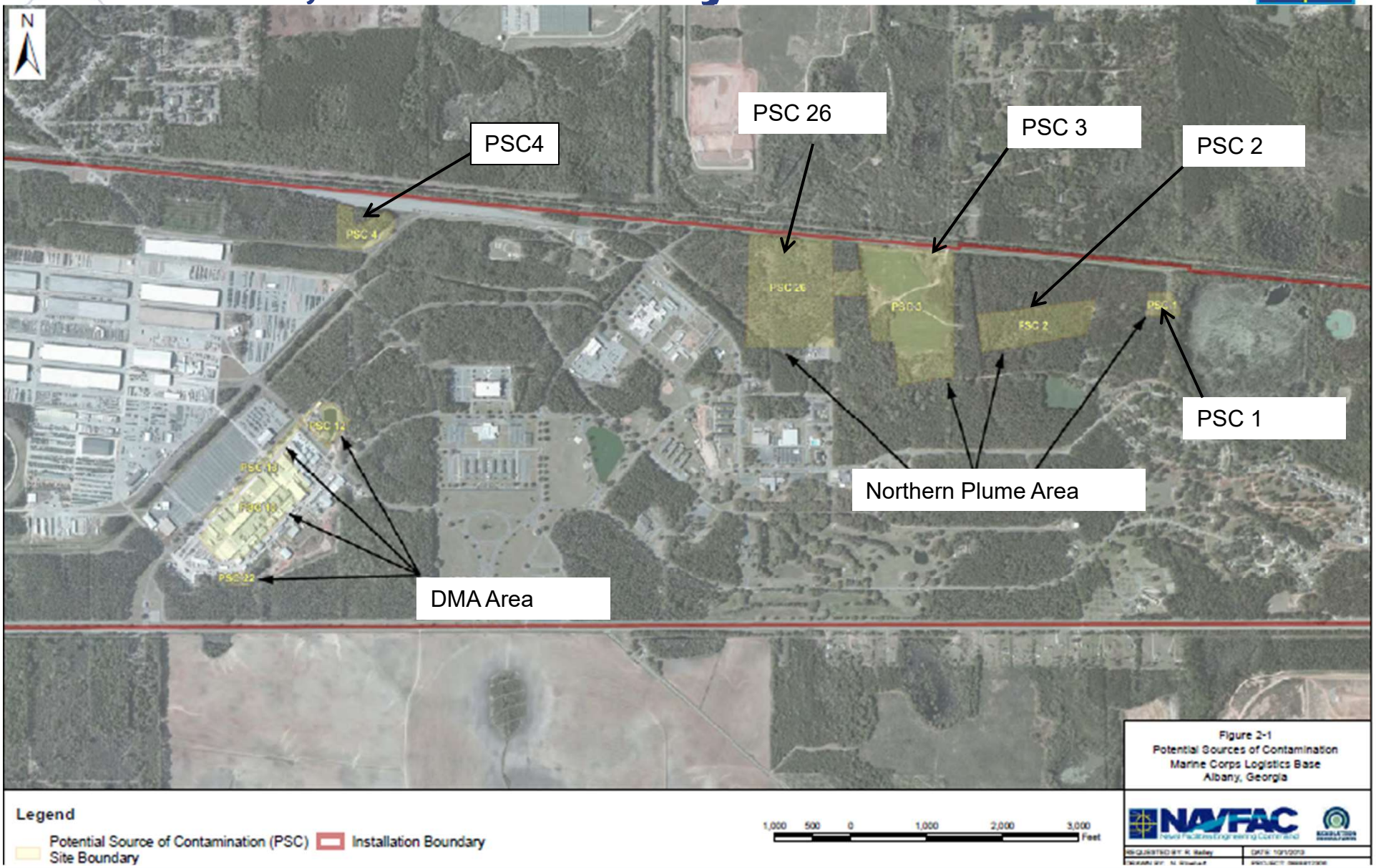


Revised CSM

- The revised CSM indicated multiple aquifers separated by confining layers
- Suspect residential water supplies penetrated several multiple confining layers, into deeper aquifers and were characterized by upward hydraulic head.
- Drilling logs were obtained and reviewed for several residential water supply wells and found that well construction included the “grouting” of wells through the confining layers.
- Regional stratigraphy indicated groundwater flow to be in the opposite direction of the shallow aquifer.
- The stratigraphy also indicated a pinching off effect of shallow aquifers found on site

OU6, MCLB Albany

OU6, MCLB Albany



Northern Plume Area (NPA)

- PSC 1 – Inactive landfill
- PSC 3 – Long-term landfill (Trench-and-fill landfill operated from 1954-1988)
- PSC 26 – Containment Berm Area
- PSC 4 – Warehouse disposal area landfill trench
- PCE, TCE, cDCE, CT in groundwater

PSC 3 Landfill

Source: NAVFAC SE 2009

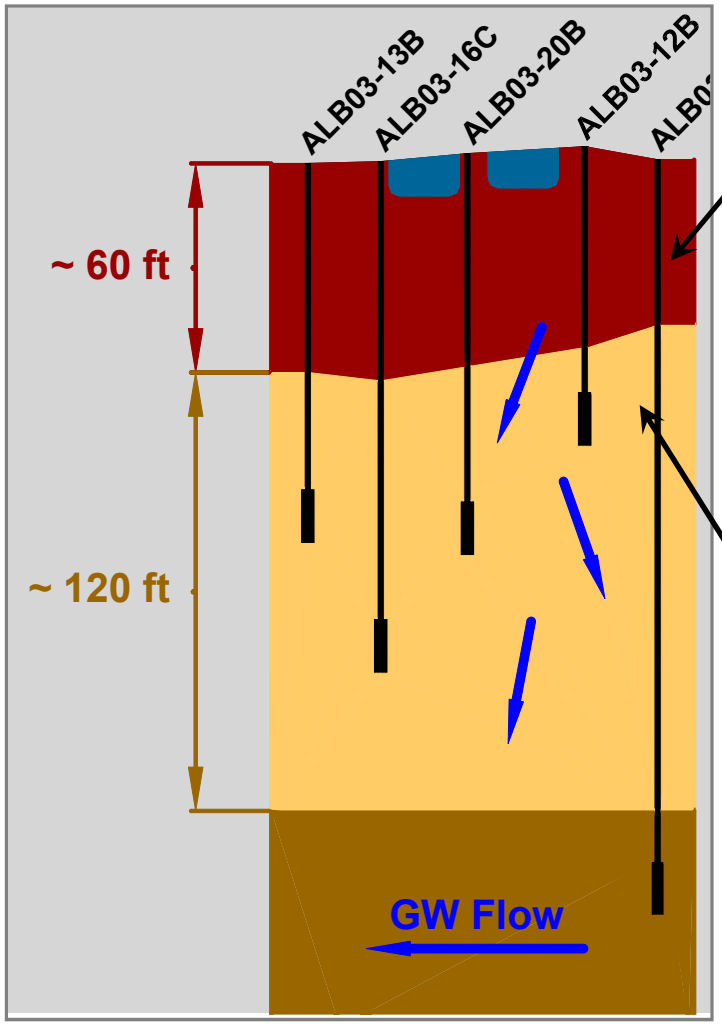
Depot Maintenance Area (DMA)

- PSC 10 – Central Repair Division
- PSC 12 – Industrial WWTP
- PSC 13 – Industrial wastewater pipeline
- PSC 22 – Former DMA 90-day storage area
- TCE, cDCE, BTEX in groundwater

Source: NAVFAC SE 2009

Geology

- Overburden 40-80 feet
  - Fine to coarse grained quartz sand and non-calcareous clay
- Upper Water Bearing Zone (UWBZ)
  - Fine grained (chalky) highly weathered limestone
  - Hydraulic conductivity ranges 0.01-10 feet/day
  - Seepage velocity 20 feet/yr
- Lower Water Bearing Zone (LWBZ)
  - Highly fractured, recrystallized, dolomitic limestone
  - Seepage velocity < 1 foot per year




Fat clay overburden (likely residuum) with sand seam (transmissive zone) and relict limestone.


Friable, chalky weathered limestone (top of Ocala Limestone).

Source: NAVFAC SE 2009, NAVFAC MidLant 2017

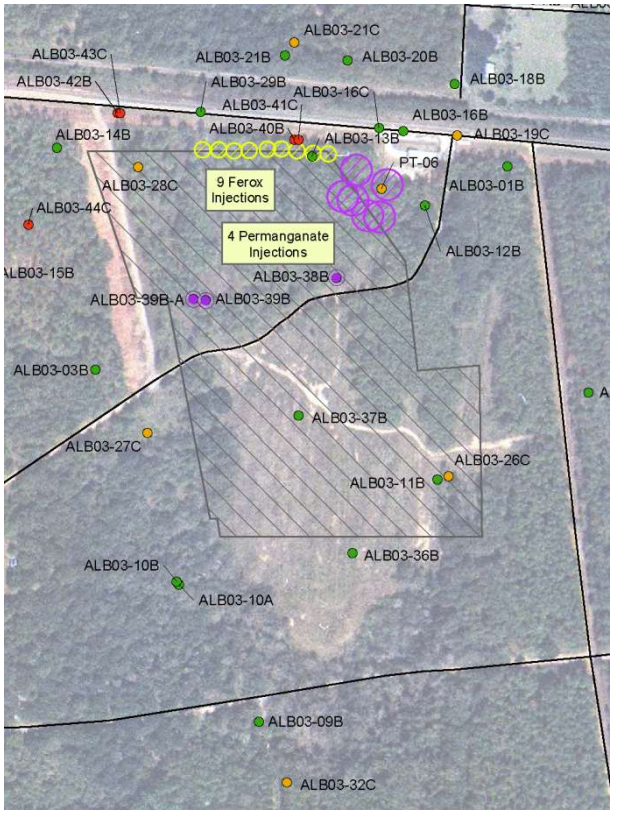
2005 Groundwater Remedy

- **NPA**
  - PSC 1: Permanganate injection
  - PSC 3: ZVI (micro) and permanganate injections
  - PSC 26: Permanganate injections
- **DMA**
  - PSC 22: Permanganate injections
- Pneumatic injection process
- Landfill cover (ET)
- Base-wide MNA
- Public water supplied to residents within 1 mile of installation

Original Remedial Design 2004

Design optimization review raised concerns with drilling through landfill waste material

Focused Injections 2005



Source: NAVFAC SE 2009

Landfill Presumptive Remedy

- Landfill Cap
- Groundwater Plume Containment
- Institutional Controls to Supplement Engineering Controls
- Long-Term Monitoring
- *Any treatment would focus on controlling plume migration*

Initial MCLB Albany 20-yr ROD goal of meeting MCLs over entire plume not consistent with Landfill Presumptive Remedy Guidance

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Directive No. 9355.0-49FS; EPA 540-F-93-035; PB 93-963339; September 1993

EPA

Presumptive Remedy for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division 5203G

Quick Reference Fact Sheet

Since Superfund's inception in 1980, the remedial and removal programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, types of disposal practices, or how environmental media are affected. Based on information acquired from evaluating and cleaning up these sites, the Superfund program is undertaking an initiative to develop presumptive remedies to accelerate future cleanups at these types of sites. The presumptive remedy approach is one tool of acceleration within the **Superfund Accelerated Cleanup Model (SACM)**.

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

This directive establishes **containment** as the presumptive remedy for CERCLA municipal landfills. The framework for the presumptive remedy for these sites is presented in a streamlining manual entitled *Conducting Remedial Investigations Feasibility Studies for CERCLA Municipal Landfill Sites*, February 1991 (OSWER Directive 9355.3-11). This directive highlights and emphasizes the importance of certain streamlining principles related to the scoping (planning) stages of the remedial investigation/feasibility study (RI/FS) that were identified in the manual. The directive also provides clarification of and additional guidance in the following areas: (1) the level of detail appropriate for risk assessment of source areas at municipal landfills and (2) the characterization of hot spots.

BACKGROUND

Superfund has conducted pilot projects at four municipal landfill sites[1] on the National Priorities List (NPL) to evaluate the effectiveness of the manual *Conducting Remedial Investigations Feasibility Studies for CERCLA Municipal Landfill Sites* (hereafter referred to as "the manual") as a streamlining tool and as the framework for the municipal landfill presumptive remedy. Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (or NCP), EPA's expectation was that containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable. The results of the pilots support this expectation and demonstrate that the manual is an effective tool for streamlining the RI/FS process for municipal landfills.

[1] Municipal landfill sites typically contain a combination of principally municipal and to a lesser extent hazardous wastes.

Since the manual's development, the expectation to contain wastes at municipal landfills has evolved into a presumptive remedy for these sites. Implementation of the streamlining principles outlined in the manual at the four pilot sites helped to highlight issues requiring further clarification, such as the degree to which risk assessments can be streamlined for source areas and the characterization and remediation of hot spots. The pilots also demonstrated the value of focusing streamlining efforts at the scoping stage, recognizing that the biggest savings in time and money can be realized if streamlining is incorporated at the beginning of the RI/FS process. Accordingly, this directive addresses those issues identified during the pilots and highlights streamlining opportunities to be considered during the scoping component of the RI/FS.

See EPA Publication 9203.1-02I, SACM Bulletins, *Presumptive Remedies for Municipal Landfill Sites*, April 1992, Vol. 1, No. 1, and February 1993, Vol. 2, No. 1, and SACM Bulletin *Presumptive Remedies*, August 1992, Vol. 1, No. 3.

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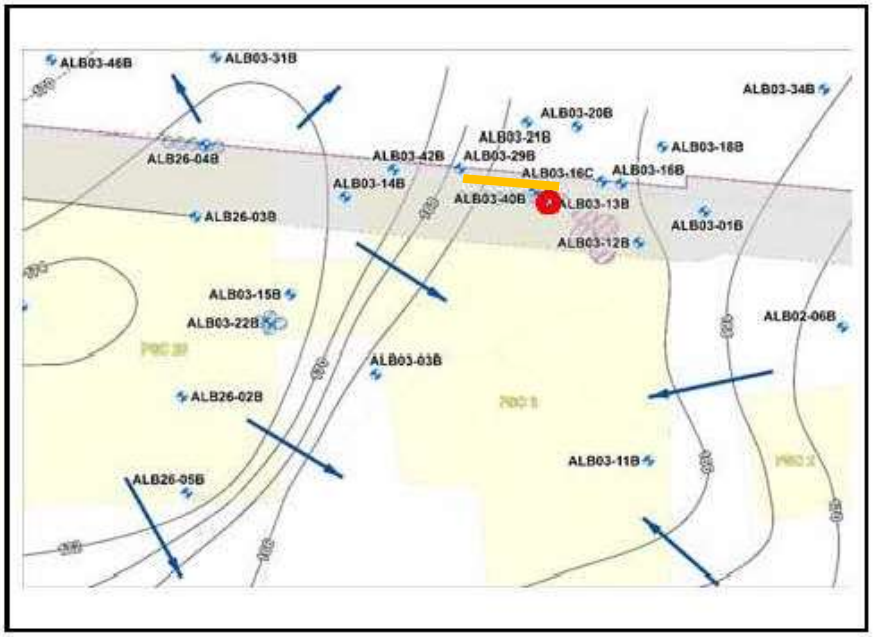
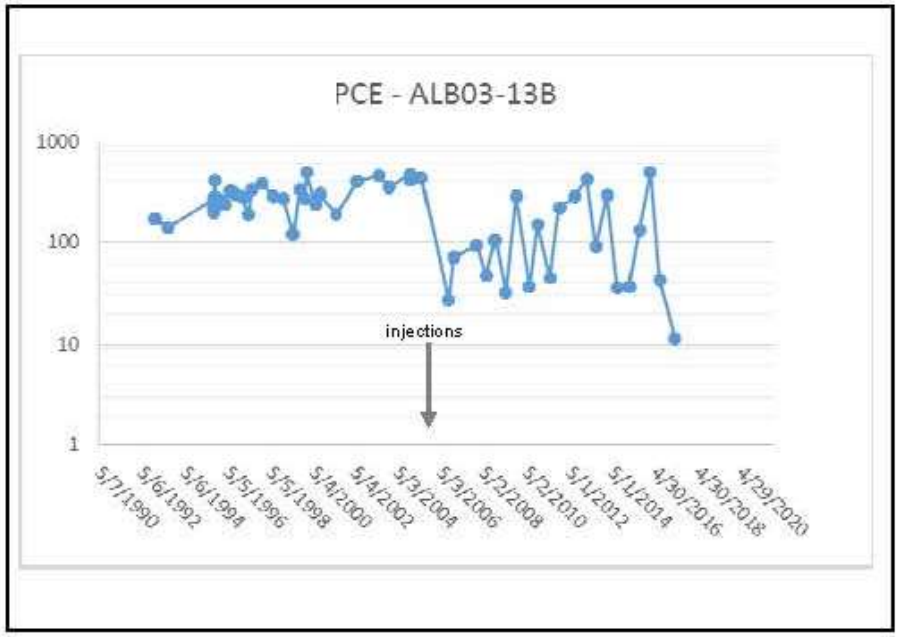
Remedy Performance – LF Interior

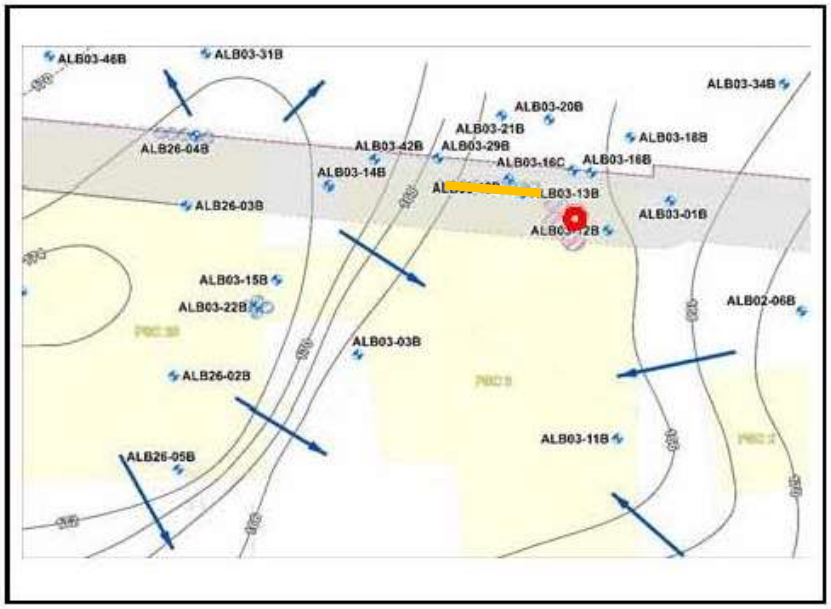


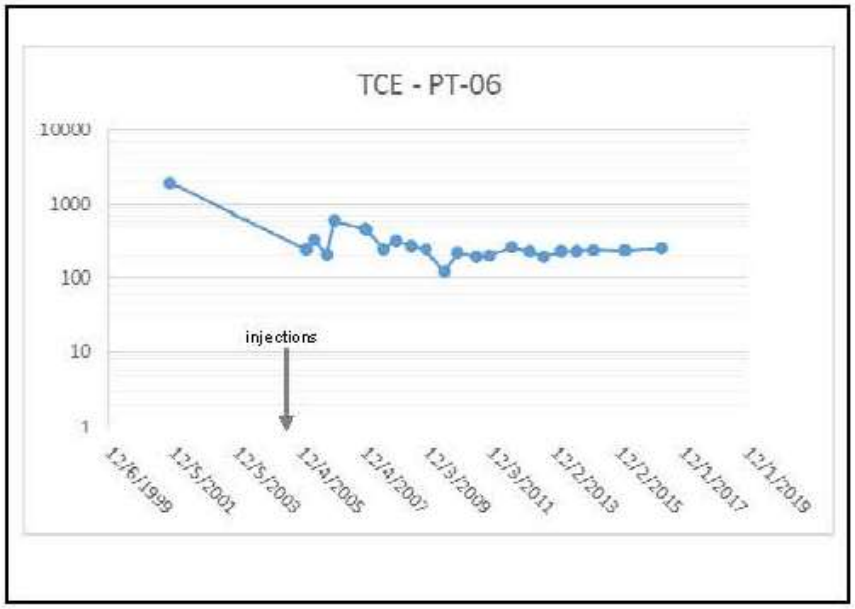


Source: NAVFAC MidLant 2017

- ALB03-13B 16 ft from closest ZVI/MnO_4injection point
- Initial reduction in PCE from 440 µg/L (06/05) to 70.7 µg/L (12/06)
- Seasonal variability in LTM data
- Further reduction through residual treatment/MNA slowed likely due to back diffusion of contaminants with UWBZ aquifer material

Remedy Performance – LF Interior

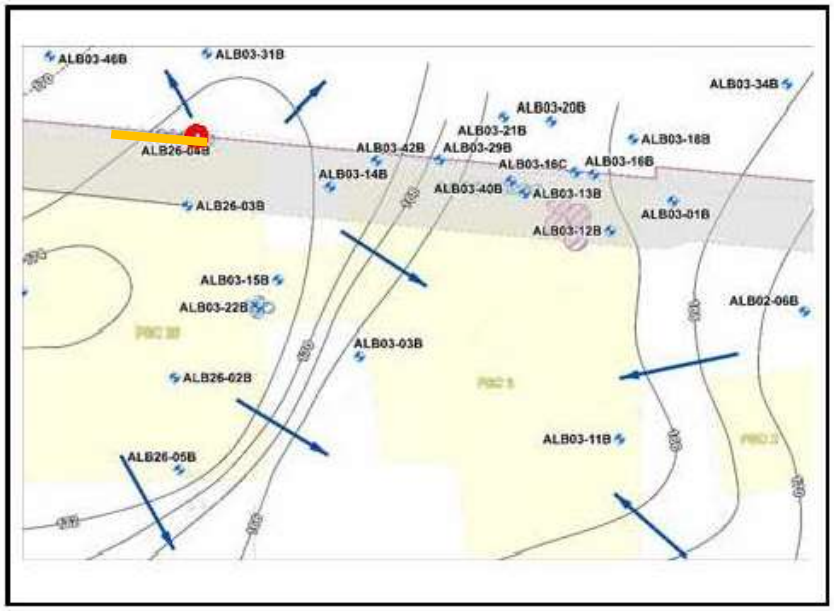


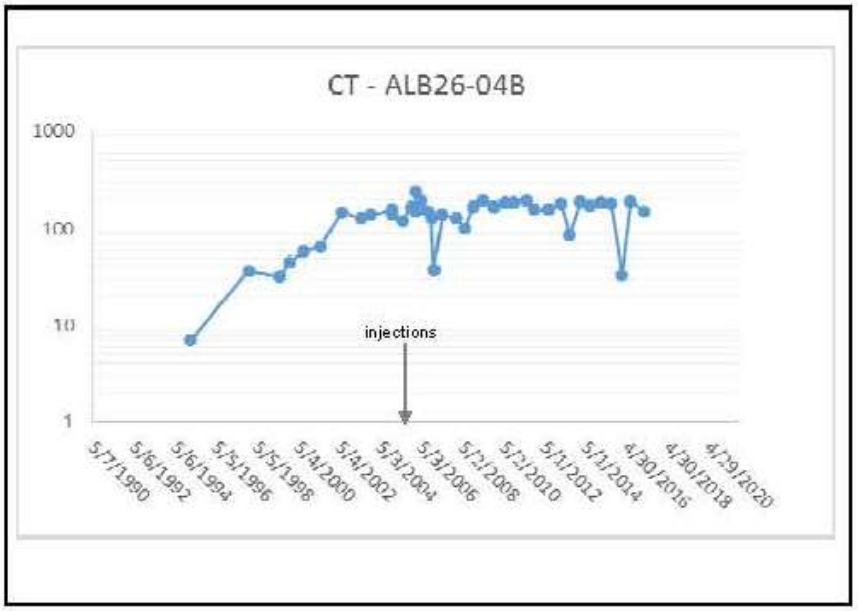


Source: NAVFAC MidLant 2017

- PT-06 installed in overburden 9 ft from closest MnO_4 injection point
- TCE decreased from 1,900 µg/L (11/01) to 601 µg/L (12/06). Further reduced to 249 µg/L (2017) over time
- Evidence of ongoing intrinsic biodegradation (e.g. elevated cDCE and VC)
- Long tailing behavior likely result of back diffusion of contaminants

Remedy Performance – Property Boundary

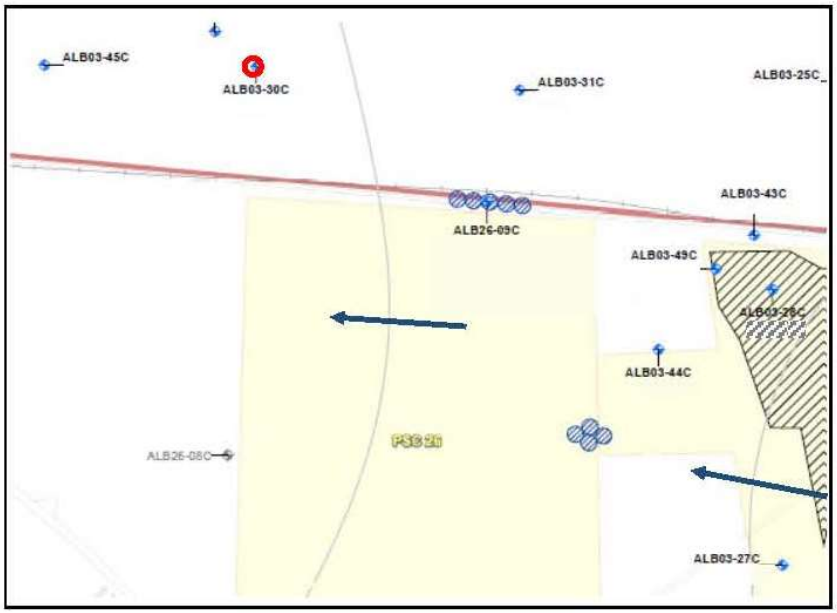


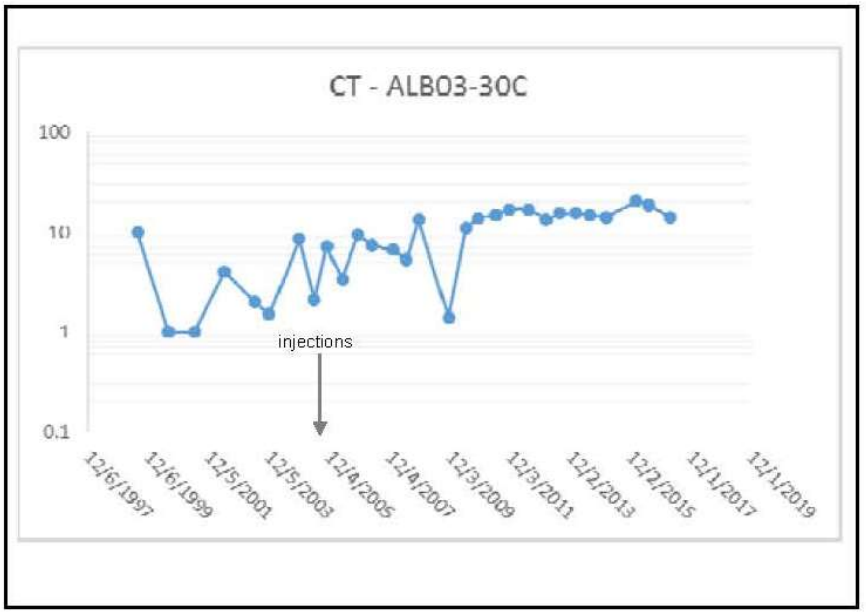


Source: NAVFAC MidLant 2017

- ALB26-04B along installation boundary 8 ft from closest ZVI injection point
- No noticeable impact from ZVI injections
- Current geochemical data (DO, ORP) indicate aerobic conditions
- Back diffusion of contaminants with UWBZ aquifer material likely serving as long-term source
- CT concentrations remained stable last 15 years

Remedy Performance – Off-Site Downgradient





Source: NAVFAC MidLant 2017

- ALB03-30C installed in LWBZ 750 ft downgradient from ZVI injected barrier
- Downgradient aquifer conditions remain aerobic
- CT upward trend from 1999-2008 may have been result of sampling techniques
- GW sampling with submersible pumps phased out in 2008 and replaced with low flow dedicated bladder pumps
- CT concentrations have remained stable for last 10 years

Summary of Remediation Efforts

- Mixed treatment results in NPA
- Complex geology made injection difficult
- Reasonable efforts made in 2005 to perform full-scale in situ injections
  - Engineered pneumatic injection process
  - Competent engineers and reputable specialty contractor
- Long-term MNA has been successful in overall containment of large dilute plumes (>200 acres)
  - Majority of wells show decreasing trends
  - Isolated zones of microbial degradation
  - Dispersion, sorption process
  - Aerobic co-metabolism?
- Back diffusion of contaminants from low permeability aquifer material likely serving as long-term source
- Attainment of MCLs unlikely in "reasonable timeframe"

Summary of Remediation Efforts

- **Partnering team continues to implement *Adaptive Site Management* approach**
  - **Using new information from specific field studies, optimization studies, and long-term monitoring data to continuously update CSM**
  - **Addressing regulatory concerns regarding potential off-site migration of CT plume**
  - **Maintaining a preference for managing the site according to the presumptive remedy guidance for landfills**
    - Residual contamination and landfill waste remain in place with minimal disturbance through drilling/sampling
  - **Seeking outside help and optimization support through NAVFAC LANT/P-OPT**
  - **Setting reasonable interim goals to guide the remediation effort**
  - **Balancing the need for risk reduction with technical feasibility and cost**

Where do we go from here……

- **What's a reasonable approach for moving forward with OU6 and addressing regulatory concerns with results from the initial remediation, potential off-site migration, and long MNA timeframe?**
  - **Long-term management of groundwater plumes (e.g. MNA, institutional controls, monitoring, exposure pathway control)?**
  - **Hot spot treatment within landfill to potentially shorten remediation timeframe?**
  - **Replenish treatment barrier along property line to provide additional plume containment?**
  - **Administrative approaches (e.g. risk assessment, TI waiver, groundwater re-classification)**
  - **Give up?**

Knowledge Check

- When performing investigation it is critical to review the CSM and adjust accordingly: Life-cycle CSM
- It is vital to understand all hydrogeological parameters that may impact your site
- Base your decisions on multiple lines of evidence
- Decisions on aggressive treatment should be made by balancing the potential for actual risk reduction with available resources
- Long-term management (passive or active) is a reasonable endpoint for many complex sites

Contacts and Questions

Points of Contact
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James M. Tarr, MS, CG NAVFAC Atlantic James.Tarr@navy.mil Tel: 757-322-4223
Questions ?

References

Hart, F.C. Associates, Inc. (1983). Initial Assessment Study of Naval Weapons Station Earle Colts Neck, New Jersey.

Sovereign Consulting, Inc. (2017). Year 18 Groundwater Monitoring Report, For Remedial Action Implementation, Building C-17/20/16/50